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Physical Land Classification of the Chungo-Cline-Nordegg Area

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PHYSICAL LAND CLASSIFICATION
OF THE
CHUNGO-CLINE-NORDEGG STUDY AREA

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19. Deep Basin
20. Lakeland
21. East Beaver Lake
22. Easy and Dry Creeks
23. Sunland Drainage

ABSTRACT

The Chungo-Cline-Nordegg area lies within the Rocky Mountain Foothills and the Front Ranges of the Rocky Mountains. The elevation in the northern part of the area is about 1 310 masl along the Brazeau River and increases to about 3 600 masl in the Rocky Mountains. The Bighorn Range has an elevation of 1 890 masl.

The area is hilly and mountainous and exhibits a ridged pattern in which steep-sided ridges are separated by narrow valleys. There is a great variety of glacial alpine morphology such as cirques, horns and hanging valleys in the area.

The bedrock in the Front Ranges is predominately sedimentary and metamorphic. The rock strata range in age from Precambrian to Jurassic and include mainly limestones, dolomites and sandstones. In the Foothills, thick-bedded sandstone and sandy shale of Cretaceous age are the dominant rocks.

The area was glaciated during the Pleistocene. Parent geological material consists of till, saprolite, glaciofluvial, colluvium, fluvial and organic deposits. Glacial depositional features are of minor importance in the Rocky Mountains.

The predominant soils in the study area are Eluviated Eutric Brunisols and Brunisolic Gray Luvisols. Regosolic soils prevail on recent fluvials, fluvial fan deposits and on colluvium. Organic soils, usually Mesisols, occur in poorly drained areas.

The study area is covered with coniferous and mixedwood forests. Dominant tree species are lodgepole pine, white spruce and, to a lesser extent, aspen and black spruce.

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PREFACE

The physical land classification of the Chungo-Cline-Nordegg area was initiated in 1981 at part of a continuous program by the Renewable Resource Inventory Section to meet the needs and requirements of resource planning and management agencies within the department and other interested governmental and research groups. The purpose of this report and accompanying physical land classification maps is to provide data on the characteristics, lcoation and areal distribution of the physiographic regions, subregions, geomorphic systems and geomorphic units of the study area.

The report provides a background information on physical characteristics of the area. This is followed by outlining the methodology employed in the physical land classification.

In the report, physiographic regions and subregions are described in detail; their associated geomorphic systems are characterized in terms of genetic material, surface expression and soils.

The maps (83C/1, 2, 5, 6, 7, 8, 9, 10, 15, 16; 82N/15, 16) at a scale of 1:50 000 show the location and extent of the individual geomorphic units as well as other levels of delineations. A general map at a scale of 1:250 000 indicating the distribution of the geomorphic systems accompanies this report. The geomorphic units are identified on the map by symbols. For a complete meaning of the map symbols, the detailed legend on the map should be consulted.

It is important to indicate that the basic purpose of this study is to provide information for broad or regional levels of resource planning and management. For detailed on-site planning and management, on-site examination is necessary.

1. INTRODUCTION

1.1 Location and Extent

The study area covers about 3 900 km^2 (1 500 sq. mi.) in west central Alberta (Figure 1). It lies between 116° and 117° west longitude and between 51°55' and 52°55' north latitude and includes all or parts of Townships 34 to 45, Ranges 14 to 21, West of the Fifth Meridian. The study area represents R3 and R6 Management Units.

1.2 Physiography and Topography

The Chungo-Cline-Nordegg area lies within the Rocky Mountain Foothills and the Front Ranges of the Rocky Mountains. The altitude in the northern part of the area is about 1 310 masl along the Brazeau River and increases to about 3 600 masl in the Rocky Mountains. The Bighorn Range, which is an outlier of the Rocky Mountains Front Range, has an elevation of 1 890 masl and trends diagonally across the southwestern part of the Foothills Region.

All prominant topographic features in the area are related to the structure and lithology of the underlying bedrocks and their differential resistance to erosion. The landscape changes

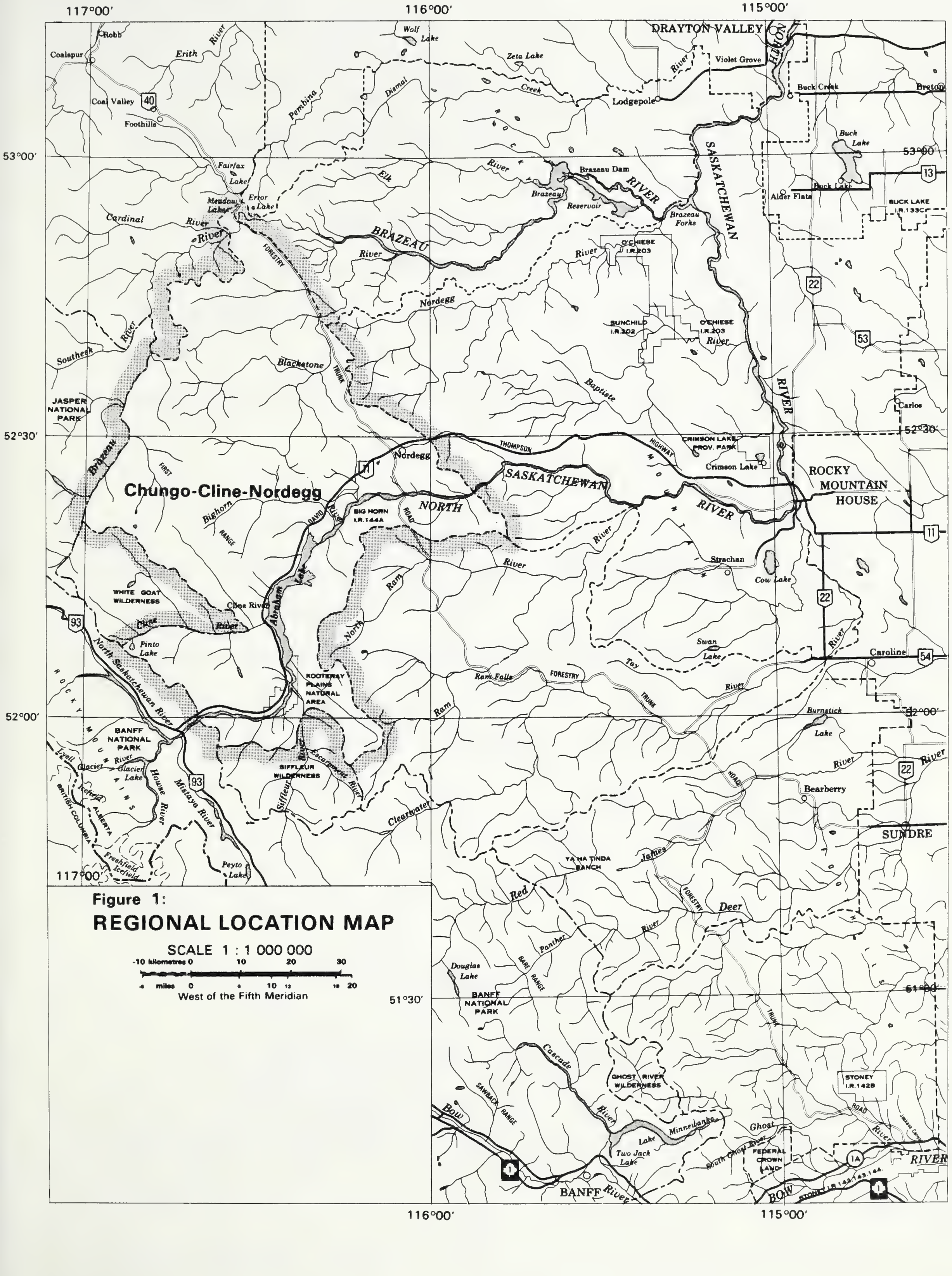

Figure 1:

REGIONAL LOCATION MAP

SCALE 1 : 1 000 000

West of the Fifth Meridian

gradually from low hills in the east and northeast to rugged mountains in the west and southwest.

The Front Range of the Rocky Mountains, bounded on the northeast by the McConnell thrust fault (Tokarsky 1971) occupies the southwestern portion of the study area. The area is charact-ertized by a series of sub-parallel, westerly dipping thrust blocks which exhibit sharp peaks, knife-edge ridges and very steep-sided valleys.

The Foothills lies to the northeast of the Front Ranges and consist of northwest-trending ridges separated by narrow valleys. The Bighorn Range runs parallel to the First Range and cuts diagonally across the southwestern part of the Foothills.

One of the major physiographic features is the North Saskatchewan Valley which provides access to the Front Range. The valley has an average width of 6 km. Downstream of the Cline-North Saskatchean junction the valley is much narrower, with an average width of 1.5 km.

1.3 Bedrock Geology

The study area is underlain predominantly by rocks of Mesozoic and Palozoic age (Green 1972) (Figure 2). Intense folding and thrust faulting in the area has caused exposure of a variety of formations.

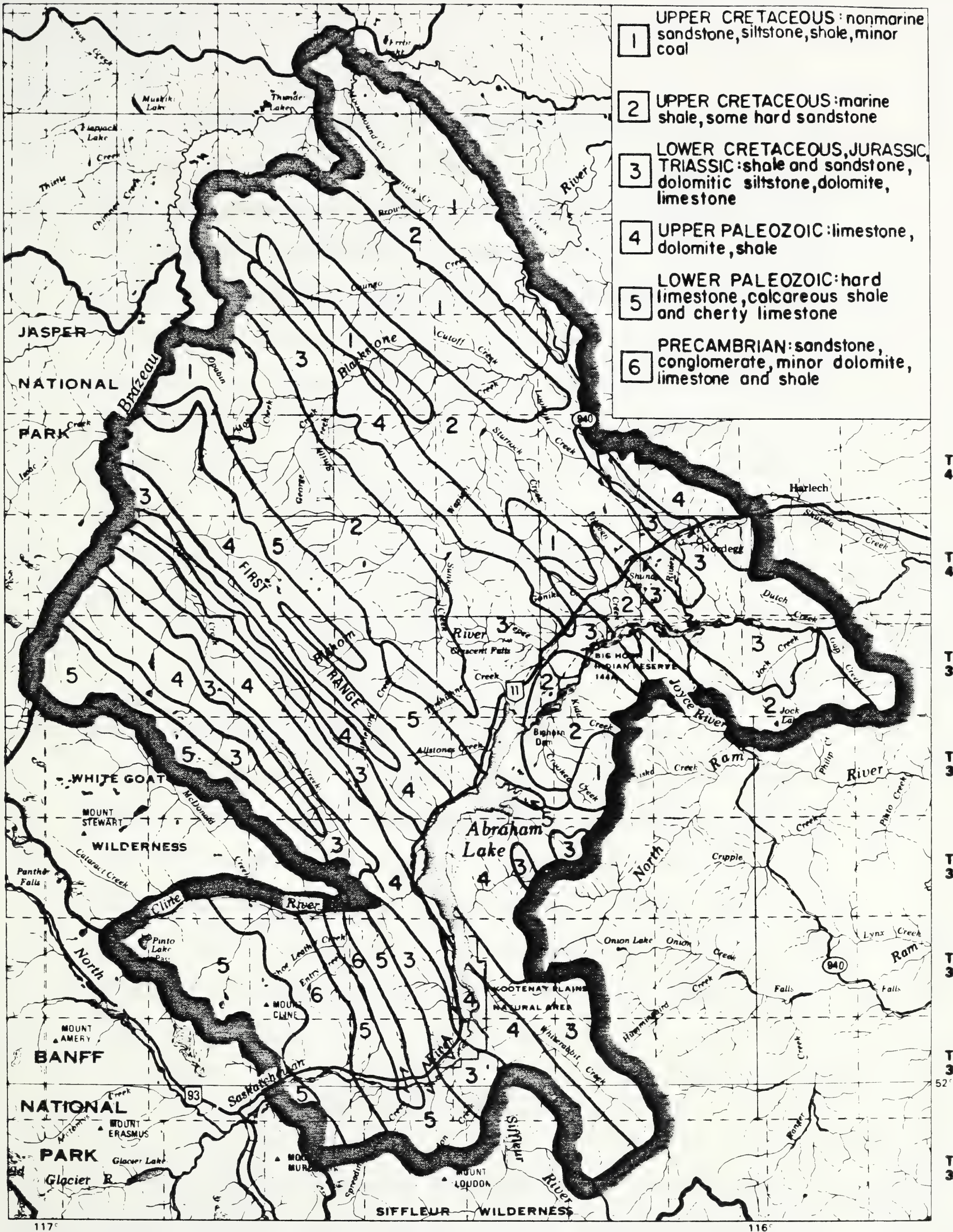

FIGURE 2 : BEDROCK GEOLOGY

AFTER GREEN (1970)

The Foothills Region is entirely of sedimentary origin. It consists of nonmarine, thick-bedded sandstone, sandy shale and blocky grey mudstone belonging to the Brazeau Formation of Upper Cretaceous age. The Brazeau Formation is underlain by thick marine shales, siltstones and sandstones of the Blackstone and Wapiabi Formations (Alberta Group) which are exposed in some portions of the area. The ridges in the Foothills are generally composed of relatively resistant sandstone whereas the valleys have been eroded out of the softer shales and argillaceous sandstones. The Bighorn Range, an outlier of the Front Range, is underlain mainly by Jurassic and Triassic rocks; hard limestone, calcareous shale, cherty limestone are the dominant rocks.

In the Rocky Mountains, the bedrock is predominantly sedimentary and metamorphic. The rock strata includes a variety of limestones, dolomites, sandstones, shales, quartzites and conglomerates ranging in age from Precambrian to Jurassic (McPherson 1970). Paleozoic (mainly Devonian) rocks consisting of limestone, dolomite and calcareous shales form the major ridges. The topographic lows, including the North Saskatchewan River valley, are underlain by weaker Mesozoic rocks composed of sandstone and shales.

1.4 Quaternary History

The surficial deposits and landforms of the Chungo-Cline-Nordegg area were affected by the major Wisconsin advance of the

cordilleran glacier. Although the topography of the area is controlled principally by the structure of the underlying bedrock, glaciation and subsequent stream action have played an important role in producing the present landscape. Glaciation appears to have served primarily to widen, presumably, former V-shaped valleys into U-shaped ones, and to produce a variety of glacial landforms.

The study area was apparently covered by an ice sheet during the early Wisconsin. Glaciers from the Rocky Mountains became sufficiently active to move over the Foothills and plains, and coalesced with the Laurentide ice which had moved westward from central Canada (Huesser 1956). The minimum thickness of the ice sheet in the Foothills is indicated by the presence of glacially transported erratics on Brazeau Range, at elevations as high as 2 100 m (Erdman 1950).

On the southwest, in the Rocky Mountains, the glaciers originated from the eastern side of the Continental Divide occupied the valleys and the middle and upper slopes of the mountains leaving only the higher peaks unglaciated. The valleys of the North Saskatchewan, Cline and Brazeau rivers all show evidence of having been occupied by ice.

1.5 Surficial Deposits and Landforms

The principle surficial deposits found in the study area are till, saprolite and colluvium. Recent fluvial deposits, fluvial fan, glaciofluvial, eolian and organic materials are of limited extent.

Till is an unsorted, unstratified glacial deposit and in the Foothills Region covers the majority of the valleys and lower slopes where erosion has not been effective. The morainal material on steeper slopes occurs as a veneer and includes a large percentage of rock fragments derived from the underlying bedrock. The dominant landform associated with the till deposits is ground moraine in most of the area. In the Nordegg area, however, an extensive ground moraine, in which grooves, flutings and drumlin fields are common, occurs between Shunda and Haven Creeks. The flutings and drumlins trend in a southwesterly direction indicating the direction of local ice lobe movement. In the Crooked Creek area, east of Abraham Lake, the till superimposed on the bedrock indicates distinct ridged patterns with a clear northeast to southwest linear orientation.

Saprolite is a residual material that has been formed *in situ* by weathering of the underlying bedrock. It is extensive on ridges and in steeply sloping aras of the Foothills and the Bighorn Range. The thickness of the material varies considerably. Those on the upper slopes are generally shallow (less than 50 cm) and contain high amounts of angular fragments incorporated from the underlying bedrock. The thickest deposits are found at or near the lower slopes where a colluvium deposit is often associated with the residual material.

Colluvial deposits are imperfectly sorted materials that have been moved primarily by gravity. They are produced mainly by

mass wasting processes and include a wide variety of landforms ranging from talus cones to rockslides. Talus is an accumulation of coarse debris derived from bedrock by frost shattering. Large accumulations of talus are found at the base of most steep cliffs and mountain slopes in the Rocky Mountains Region. Active talus production in the form of cones takes place on most rock outcrops not covered by vegetation. In some barren rock areas, rockslides consisting of extremely coarse and angular rubble are the main surficial materials.

Recent fluvial deposits occur on river and stream floodplains with largest areas being found in the valleys of North Saskatchewan, Cline, Brazeau and Blackstone Rivers. These sediments are composed dominantly of sands and gravels. Occasionally lenses and patches of silt and clay are also present.

Fluvial fans developed by upland streams are found mainly along the sides of the North Saskatchewan valley. They are cone or fan-shaped deposits and consist of gravels and rubbly materials. A number of the fans may contain a large proportion of sand, silt and clay due to the influence of mudflows. The size of the fans varies considerably. Some are several kilometres across and show entrenchment by the main stream.

Glaciofluvial materials are sediments deposited by glacial meltwaters. In the study area, they are confined to the valleys of main rivers and creeks. Major outwash gravel and sand deposits are

found in the North Saskatchewan valley within the Rocky Mountains Region. A number of terraces between the Siffleur and Cline rivers have a thick deposit of sands and gravels.

A thin eolian veneer consisting of silt loam to fine sandy loam loess material is common on the lower slopes of the Foothills and in the valleys of the North Saskatchewan and Cline rivers.

There are only a few small organic areas, mainly in the Foothills Region. They are formed in depressional and level landscape positions where surface water accumulate.

1.6 Drainage

The area is drained by the North Saskatchewan, Siffleur, Cline, Bighorn, Blackstone and Brazeau rivers and their many tributaries. The North Saskatchewan River enters the area from the south and cuts obliquely through the Front Ranges. It flows north, makes a turn eastward and continues flowing east out of the study area. The Brazeau River constitutes a portion of the western boundary of the area and flows north.

2. METHODOLOGY

The Physical Land Classification Methodology (Land Classification Section 1978) provides guidelines for the systematic delineation of land areas based on the principle of recognizing the geomorphic nature of the earth's surface along with an understanding of structure, genesis and process as reflected in the landforms, parent material, soils and topography.

The classification includes four categories or hierarchical levels (Table 1). The broadest of these categories, the physiographic region, is defined on the basis of elevation, relief and structural geologic formations. Category 2, the physiographic sub-region, is a subdivision of the physiographic region with defined patterns of relief, geology and geomorphology. The geomorphic system, Category 3, represents the component parts of a sub-region with recurring patterns of landforms, as defined and distinguished by mode of origin (genesis), composition and surface expression. Category 4, the geomorphic unit, is a homogeneous area of land in terms of parent material, surface expression, soil texture, slope, aspect and drainage. This is the fundamental unit that can be rated for ecological suitability.

Table 1

LEVELS OF CLASSIFICATION

Classification Level	Delineating Criteria	Scale of Derivation
Physiographic Region	Elevation, relief and structural geologic formations.	1:1 000 000 to 1:3 000 000
Physiographic Sub-region	Definite patterns of relief, geology and geomorphology.	1:500 000 to 1:1 000 000
Geomorphic System by Genetic Composition	Recurring pattern of landforms distinguised (surficial materials) and surface expression.	1:50 000 to 1:250 000
Geomorphic Unit	Homogeneous areas of land with inherent properties of genetic composition (surficial material), surface expression, texture, slope (type and %), aspect, erosional and depositional modifiers, integration of soils (subgroup level - CSSC) and internal drainage (CSSC).	1:5 000 to 1:50 000

2.1 Interpretation

The physical land classification of the Chungo-Cline-Nordegg area was based primarily on systematic aerial photo interpretation augmented by field data and existing inventory and research information.

Initially, small-scale maps were used to delineate the physiographic regions and subregions of the area. Further separations were then made, on the basis outlined in the methodology, by interpretation of aerial photographs at a scale of 1:60 000. The results of the systematic aerial photo interpretation were then transferred to topographic maps, at a scale of 1:50 000, and was used as a basis in the ensuing field work. The final physical land classification maps of the area are a composite of the information obtained from the aerial photographs, field work conducted in the area, and the data from previous studies.

2.2 Field Procedures

The aerial photo interpretation was verified and supplemented with field work conducted in the summer of 1982. Field plots were chosen to characterize individual geomorphic systems and units. Wherever possible, soil pits and any other available exposures such as road cuts and river banks were examined to determine the parent material and soil type, and to assess landforms, slope and drainage conditions. The soils in the area were classified according to the Canadian System of Soil Classification

(1978) into soil subgroups within the various great groups and orders. The classification of the soils into subgroups was based mainly on the kinds and degree of soil development and on the sequence of soil horizons and layers in soil profiles. Other soil properties measurable in the field, such as soil texture, color and thickness of horizons, soil structure and consistency, stoniness and soil pH, were recorded.

The study area is heavily forested and access is difficult, particularly on steep terrain. In these areas, a helicopter was used for examination of sites.

3. PHYSICAL LAND CLASSIFICATION

The first level of division, the physiographic region, is based on major differences in elevation, relief and structural geologic formation. Each region outlines areas that are topographically alike and within which the genesis of the landforms is understood. The process of erosion and deposition within these areas are similar (Land Classification Group 1978). They are distinguishable at a scale of 1:1 000 000 to 1:3 000 000. There are two major physiographic regions defined in the study area (Figure 3):

1. Rocky Mountain Foothills Region
2. Rocky Mountains Region

The Foothills Region occupies the northeastern half of the study area and includes the Bighorn Range physiographic subregion. The Rocky Mountains region covers the remainder of the area and constitutes geomorphic systems and units only.

There are 16 geomorphic systems; 11 in the Foothills Region and five in the Rocky Mountains region. These are essentially landform - parent geologic material subdivisions and are described broadly within their respective region.

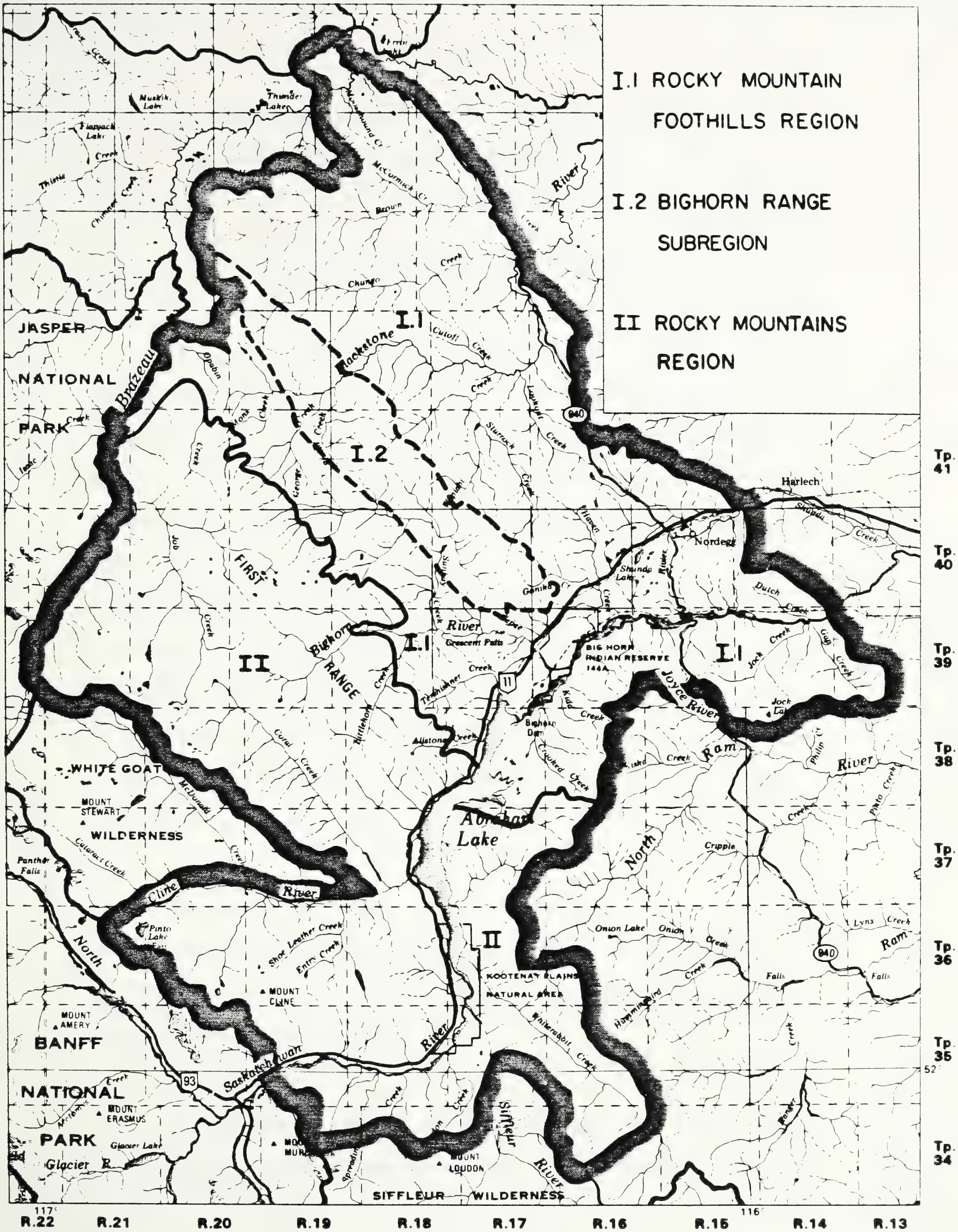

FIGURE 3: PHYSIOGRAPHIC SUBDIVISIONS OF THE CHUNGO-CLINE-NORDEGG STUDY AREA.

The geomorphic units, which indicate homogeneous areas within the geomorphic systems, are identified on the map by symbols.

3.1 Rocky Mountain Foothills Region

This region is mainly hilly and consists of steep, approximately parallel ridges aligned in a northwestern to southeastern direction. The ridges become less discernible in the northeastern part of the region between the North Saskatchewan and Blackstone rivers where they occur as an independent hill or as part of a larger hill. The general landscape is characterized by bedrock-controlled landforms and is dissected by the North Saskatchewan and Blackstone rivers and their tributaries. These major river valleys are wide, relatively flat-bottomed and have gently sloping sides. In contrast to these, the interfoothill valleys which are adjusted to the northwest-southeast trend of the ridges are usually deeply incised and have steep valley walls.

The elevation in the region is about 1 400 m along its northeastern boundary and increases to 2 000 m on the northeast of the First Range. The lowest elevation, along the Brazeau River in the north, is about 1 300 masl.

The bedrock is mainly composed of Upper and Lower Cretaceous, Jurrasic and Triassic rocks. The Edmonton Formation

consisting of sandstone, shale, conglomerate and coal underlies a small area adjacent to the Brazeau River in the north. Southward, the Brazeau Formation underlies the area; sandstone and shale are the dominant rocks. In the Mccormick and Brown Creek areas, the Wapiabi Formation is the main unit. It consists of black marine shale, sandy shale, quartzitic sandstone and some ironstone. The Brazeau and Wapiabi formations alternate in the area northeast of the Bighorn Range. The Bighorn Range is underlain mainly by hard limestone, calcareous shale and cherty limestone of Mesozoic and Paleozoic age. Between the Bighorn Range and the Rocky Mountain Front Range the formations are of Upper and Lower Cretaceous and consist largely of sandstone and shale.

The surficial deposits of the sub-region are dominantly till and saprolite (residual material). Significant areas of colluvium, and small areas of glaciofluvial, fluvial and organic materials are also present. A thin, five to 30 cm thick, fine sandy loam to silt loam loess material mantles much of the lower slopes and low-lying areas.

The till occurs generally as a veneer and/or blanket over the bedrock-controlled landscape, and on steeper slopes it is influenced by colluvial materials. On rougher terrain at high elevations, the boundary between the till and colluvium is not well defined and complexes of till veneer and colluvium do occur; there are also areas of exposed bedrock. In some of the narrow valleys

and at the base of some of the steep slopes the till is covered by a thin creep material. The texture of the till is generally sandy clay loam to clay loam, and, on steeper slopes, includes a large percentage of rock fragments.

Saprolite (residual material) is extensive in steeply sloping areas where physical disturbance eroded the till material. It is commonly developed from sandstone and shale, and generally non-calcareous. The texture is usually sandy loam and includes high amounts of bedrock fragments, especially in areas where the material is shallow and the bedrock is within 50 cm from the surface. Very often a colluvial veneer and/or slope washed deposit is associated with the residual material.

Colluvium consisting of fine materials, stones and sharp angular rock fragments forms the surface unit over some of the terrain having significant slopes. It is found on, and at the base of, long steep slopes, particularly along the sides of the main valleys. At higher elevations, colluvial material occurs as a veneer and bedrock exposures are frequent. Colluvium found at lower elevations includes some fine material due to some influence of water transportation of some of the colluvial materials.

Glaciofluvial deposits are found mainly along the North Saskatchewan, Blackstone and Brazeau rivers, and in the lower

reaches of some of the large creek valleys. They range from poorly stratified to finely stratified sediments and comprise sands, gravels and some fine materials.

Fluvial deposits are confined to the floodplains of the North Saskatchewan, Brazeau and Blackstone rivers and major streams. They are dominantly sands and gravels. Occasionally lenses and patches of silt and clay are also present. Young streams carrying coarse materials from uplands give rise to the development of fans at the base of steep slopes. There are a number of well devevoped fans in the valleys of the North Saskatchewan and Brazeau rivers.

Small areas of organic deposits with varying thickness are found in the Nordegg area and along some of the creeks. Most of these deposits are fen type, and are at an advanced stage of decomposition.

The soils of the Foothills Region are dominantly Eluviated Eutric Brunisols in combination with significant areas of Brunisolic Gray Luvisols, Eluviated Dystric Brunisols and Regosolic soils. Orthic Eutric Brunisols and poorly drained Organic and Gleysols soils constitute a small proportion of the area.

The Eluviated Eutric Brunisols are well drained soils that occur on a wide variety of landforms ranging from undulating moraine to bedrock-controlled residual veneer. The majority of the

soils have a thin (two to 10 cm thick), moderately decomposed organic surface horizon (L-H) overlying a liched, two to eight cm thick, grey, sandy loam Ae horizon which, in some profiles, is discontinuous. The Bm horizon with pH values of 5.5 or higher is generally yellowish brown to reddish brown in color, sandy loam to clay loam in texture, and commonly occurs within 15 cm of the surface. The C horizon is brown or yellowish brown in color, and has textures ranging from sandy loam to clay loam. Soils with rock substrates within 50 cm of the surface (Lithic phase) are common in strongly sloping areas. These soils generally have thin, eight to 10 cm thick, and the C horizon contains a high proportion of rock fragments. In areas where a loessial overlay is present, soils have brown to reddish brown sola with textures ranging from fine sandy loam to silt loam.

The Brunisolic Gray Luvisols are found in gently to moderately sloping areas associated with good drainage conditions. These soils have stronger soil profile development and include a Brunisolic sequence of Ae and Bm horizons in an older Ae horizon that overlies a continuous textural Bt horizon. The texture of the surface horizons is generally fine sandy loam, while that of the Bt horizon varies from clay loam to clay. In areas where the soils are associated with loess deposits, the upper solum (Ae1, Bm, Ae2) is generally in the loessial overlay, while the lower solum (Bt) is found to encroach into the underlying till.

The Eluviated Dystric Brunisols are well to rapidly drained soils and found largely on steep slopes and on the crest of many of the ridges. A few areas of this soil occur along some of the valleys containing coarse glaciofluvial deposits. The soils are identified by a thin (generally one to three cm thick), relatively decomposed organic surface horizon (L-H) overlying a liched, one to four cm thick, greyish brown Ae horizon. The Bm horizon in which the pH is less than 5.5 in value, is generally brown to yellowish brown in color and occurs within 10 cm from the surface. The Eluviated Dystric Brunisols found at high elevations have developed on residual parent material derived chiefly from the underlying sandstone. These soils are commonly shallow (less than 50 cm thick), coarse textured with bedrock fragments almost to the surface. The soil sola of these soils are generally thin, five to 15 cm thick, and reflect some of the physical and mineral characteristics of the underlying bedrock.

The Regosolic soils in the Foothills Region are generally found on post-glacial deposits such as colluvial, fluvial fan and recent fluvial materials. They have little or no profile development due to distrupted soil forming processes. These soils are identified by a surface horizon which appears to be a mixture of roots and weakly humidified organic remains with coarse to fine mineral material. The underlying soil has uniform color values with organic matter content decreasing regularly with depth. Regosolic soils confined to the high elevations are shallow and

commonly in association with extensive rock outcrops. At lower slopes, some of the Regosolic soils have a drift constituent due to slope wash which, in most profiles, gives rise to the development of an organic-mineral horizon on the surface.

Very poorly drained Organic soils are confined mainly to the southeastern part of the region. In the Nordegg area, they are found in small depressional areas experiencing excess moisture conditions. In other areas, they occupy portions of old streams or parts of former lake basins. The majority of the Organic soils in the region are influenced by nutrient-rich groundwater and have developed from non-woody vegetations dominated by sedges. They generally are well decomposed fen peat and characterized by a mesic middle tier overlying a humic layer (Humic Mesisol), or mesic middle and surface tiers in areas where a mineral contact occurs within 160 cm of the surface (Terric Mesisol).

Poorly drained Gleysolic soils occupy lower slope positions and level areas where they often grade into Organic soils. They are subject to continual or relatively continual groundwater discharge and indicate gleying as a result of reducing conditions. Most of these soils have 10 to 15 cm organic surface horizon (L-H) overlying a dull colored B horizon with many prominent mottles.

The Foothills Region is divided into eight geomorphic systems based primarily on landform and parent geologic material. A schematic distribution of the geomorphic systems within the region and their generalized description is given in Figure 4 and Table 2.

3.2 The Bighorn Range Subregion

This sub-region is an outlier of the Rocky Mountains and runs parallel to the First Range until it disappears to the northwest. The topography is characterized by very strongly sloping to steep northwest-southeast trending ridges dissected by the Blackstone River and its' tributaries. Maximum local relief in the area is about 1 000 m; the lowest elevation on the Blackstone River is about 1 600 masl, whereas the highest elevation on the range is about 2 600 m.

The bedrock consists of mainly limestone, dolomite, sandstone and shales of the Mesozoic and Paleozoic age. Most of the area is covered by residual material with sandy loam texture and variable amounts of coarse fragments making up as muich as 70 per cent of the material. There are extensive areas of exposed bedrock which, in frequent cases, is subject to mass wasting. Some morainal material (till) is found as a thin mantle covering the lower slopes where erosion has not been effective.

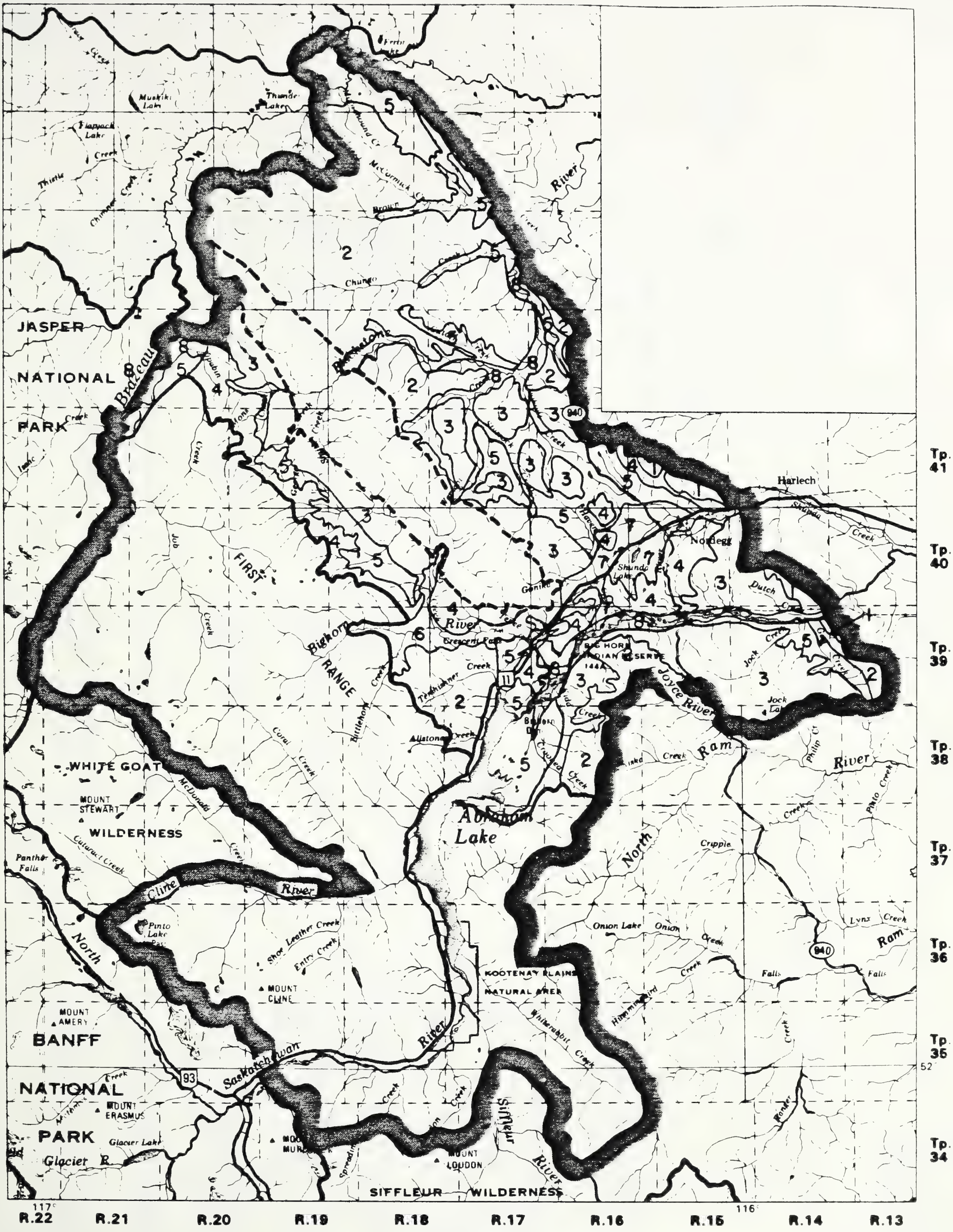

FIGURE 4: GEOMORPHIC SYSTEMS OF THE FOOTHILLS REGION

Table 2

KEY TO MAIN CHARACTERISTICS OF THE GEOMORPHIC SYSTEMS IN THE FOOTHILLS REGION

Geomorphic System	Genetic Composition	Surface Expression Slope	Soils
1	Saprolite veneer over bedrock	Ridged, inclined, steep; 45-100%	Eluviated Eutric Brunisols, some Eluviated Dystric Brunisols, frequent bedrock exposures.
2	Morainal veneer and blanket over bedrock, significant areas of saprolite	Inclined, ridged, rolling; 15-70%	Eluviated Eutric Brunisols, significant areas of Eluviated Dystric Brunisols
3	Morainal veneer and blanket over bedrock, some colluvium	Inclined, ridged; 10-45%	Eluviated Eutric Brunisols, some Regosols
4	Morainal veneer and blanket over bedrock, some fluvial	Inclined, undulating; 9-15%	Eluviated Eutric Brunisols, Brunisolic Gray Luvisols
5	Morainal blanket over bedrock, some organic	Undulating, inclined; 3-9%	Eluviated Eutric Brunisols, Brunisolic Gray Luvisols, some Organic soils
6	Morainal blanket over bedrock, some fluvial	Undulating, inclined, terraced; 3-9%	Eluviated Eutric Brunisols, Brunisolic Gray Luvisols, some Regosols
7	Morainal blanket over bedrock, organic	Undulating, ridged; 3-9%	Eluviated Eutric Brunisols, Organic soils
8	Fluvial, some glaciofluvial, organic and morainal	Terraced, undulating, fan, level, inclined; 1-3%	Regosolic soils, some Eluviated Eutric Brunisols and Organic soils

The soils of the sub-region are dominantly well drained Eluviated Dystric Brunisols and Eluviated Eutric Brunisols in combination with significant areas of Regosolic soils. Because of the steepness of the topography, the soils are in a relatively unstable condition, and the soil profile development is somewhat retarded. Majority of the soils have thin sola with a distinct Ae and a Bm horizon of high chroma. The C horizon generally contains a high percentage of bedrock fragments and occurs within 50 cm of the surface.

The Bighorn Range sub-region includes only two geomorphic systems on the basis of landform and parent geologic material. A schematic distribution of the geomorphic systems within the sub-region and their generalized description is given in Figure 5 and Table 3.

3.3 Rocky Mountains Region

This region covers the southwest half of the study area and represents the Front Ranges of the Rocky Mountains. The area is characterized by a series of sub-parallel, west dipping thrust blocks (Pettapiece 1971) which trend northwest, parallel with the trend of the Outlier Bighorn Range. The bedrock includes a variety of limestones, dolomite, sandstones and shales ranging in age from Precambrian to Jurassic (McPherson 1970). Because of a large extent of more massive and resistant rocks, unlike the more rounded

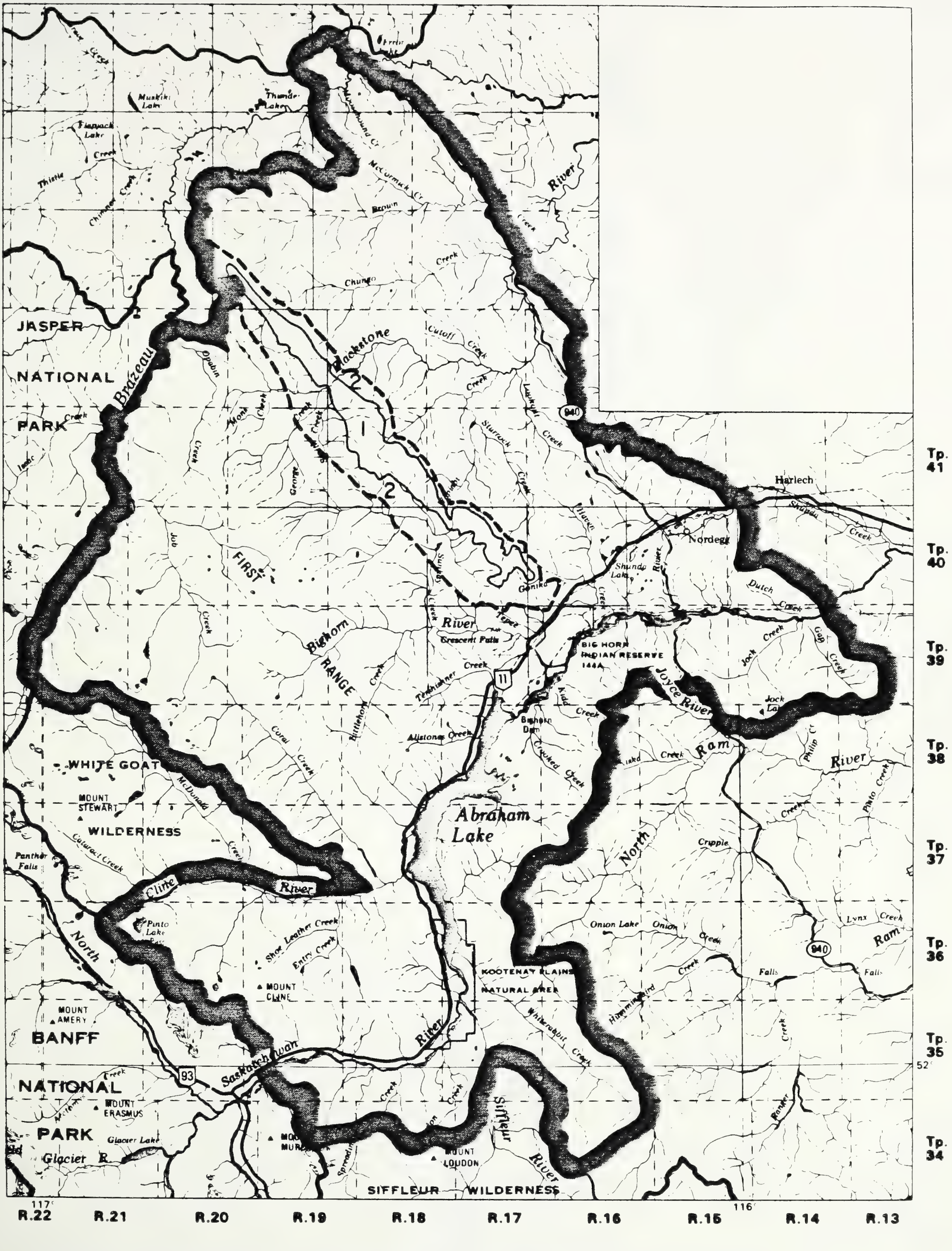
FIGURE 5: GEOMORPHIC SYSTEMS OF THE BIGHORN RANGE SUBREGION

Table 3

KEY TO MAIN CHARACTERISTICS OF THE GEOMORPHIC SYSTEMS IN THE BIGHORN RANGE SUBREGION

Geomorphic System	Genetic Composition	Surface Expression Slope	Soils
1	Bedrock, fractured bedrock, some saprolite	Ridged, steep; 45-100%	Rock outcrops (barren land), some Regosols
2	Saprolite, signficant areas of morainal veneer over bedrock	Inclined, ridged; 30-70%	Eluviated Eutric Brunisols, Eluviated Dystric Brunisols

ridges of the Foothills, the mountain ridges are very steep and display sharp peaks and associated deep canyons. These ridges rise as much as 1 800 m above the tree line.

The elevation in the region is about 1 280 m on the North Saskatchewan River and increases up to about 3 350 m on the mountain peaks. In the Cline River valley, the elevation is about 1 675 m at the upstream end and decreases to about 1 350 m at the entrance to the North Saskatchewan River.

The surficial deposits of the region are dominated by consolidated rocks of all kinds, partially weathered and fractured rocks, shallow residual and/or colluvial materials. There are extensive areas of coarse, angular, loose and nonsoil materials which, in frequent cases, are subject to gravitational movement. Glacial deposits such as till and glaciofluvial sediments are of minor importance above the tree line.

The North Saskatchewan and Cline River valleys are covered by a blanket of till and fluvial deposits of various thickness. Fluvial fans consisting mainly of gravel and rubbly materials are the major geomorphic features in the main valleys. Residual materials occupy the transional zone between valley (floodplains and fans) and rocklands on the mountain slopes. Colluvium deposits of imperfectly sorted materials produced by mass wasting processes are found at the base of most steep slopes.

In barren areas, soils are of limited occurrence and consist of poorly sorted, angular, coarse fragments and minimal fine earth material. Soil development is stunted due to constant downslope movement of materials, reduced percolation of the water through the soil, and unfavorable climatic conditions. Nonsoil materials dominant much of the landscape. Lithosols and Lithic Regosols formed in situ by weathering occur locally.

Soils in the North Saskatchewan and Cline river valleys and inclined areas adjacent to the valleys have relatively well developed profiles. They are characterized by an Ae, Bm and C horizon and classified within the Brunisolic order. On the steeper upper slopes, soils are generally shallow and include high amounts of bedrock fragments.

Regosolic soils are dominant on fluvial fans along the major valleys, and on steep slopes that are caused by colluvial and/or shallow residual materials. The soils are coarse textured and unstable due to the steepness of the topography or rapid secretion of materials.

The Rocky Mountains Region is divided into six geomorphic systems based primarily on landform and parent geologic material. A schematic distribution of the geomorphic systems within the region and their generalized description is given in Figure 6 and Table 4.

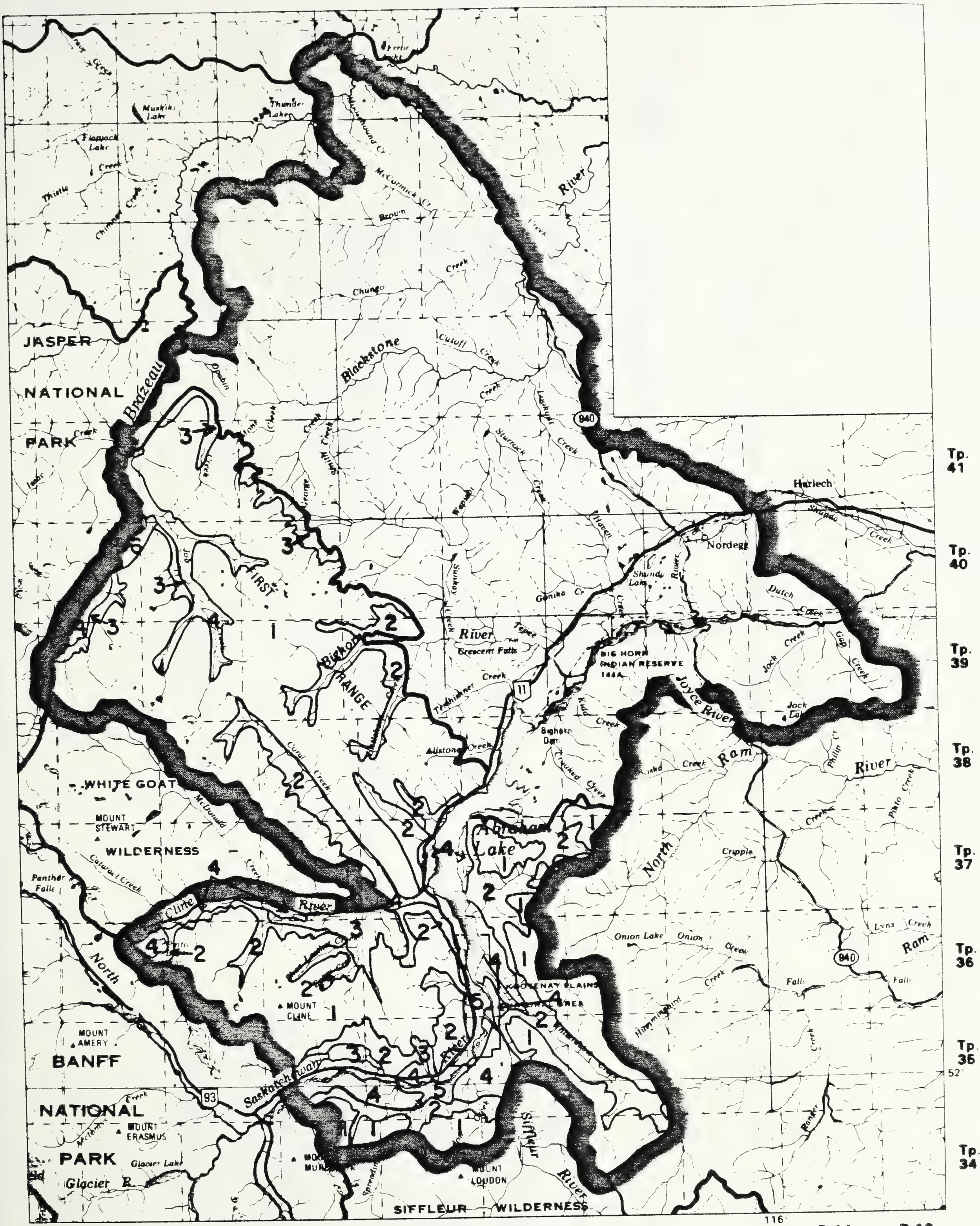

FIGURE 6: GEOMORPHIC SYSTEMS OF THE ROCKY MOUNTAINS REGION

Table 4

KEY TO MAIN CHARACTERISTICS OF THE GEOMORPHIC SYSTEMS IN THE ROCKY MOUNTAINS REGION

Geomorphic System	Genetic Composition	Surface Expression Slope	Soils
1	Bedrock, fractured bedrock, some colluvium and saprolite	Ridged, steep, 45-100%	Rock outcrops (barren land), some Regosols
2	Saprlite veneer over bedrock, colluvium, some morainal	Inclined, ridged; 30-70%	Eluviated Eutric Brunisols, Regosols
3	Morainal veneer over bedrock, saprolite, some colluvium	Inclined; 15-45%	Eluviated Eutric Brunisols, some Regosols
4	Morainal veneer over bedrock, significant areas of fluvial, some colluvium and saprolite	Inclined, undulating, fan, terraced, ridged; 3-15%	Eluviated Eutric Brunisols, Brunisolic Gray Luvisols, some Regosols
5	Fluvial, some glaciofluvial	Fan, level, terraced; 1-9%	Regosolic, some Eluviated Eutric Brunisols and Brunisolic Gray Luvisols
6	Colluvium, fluvial, some morainal	Inclined, undulating, ridged; 3-9%	Regosols, some Elulviated Eutric Brunisols

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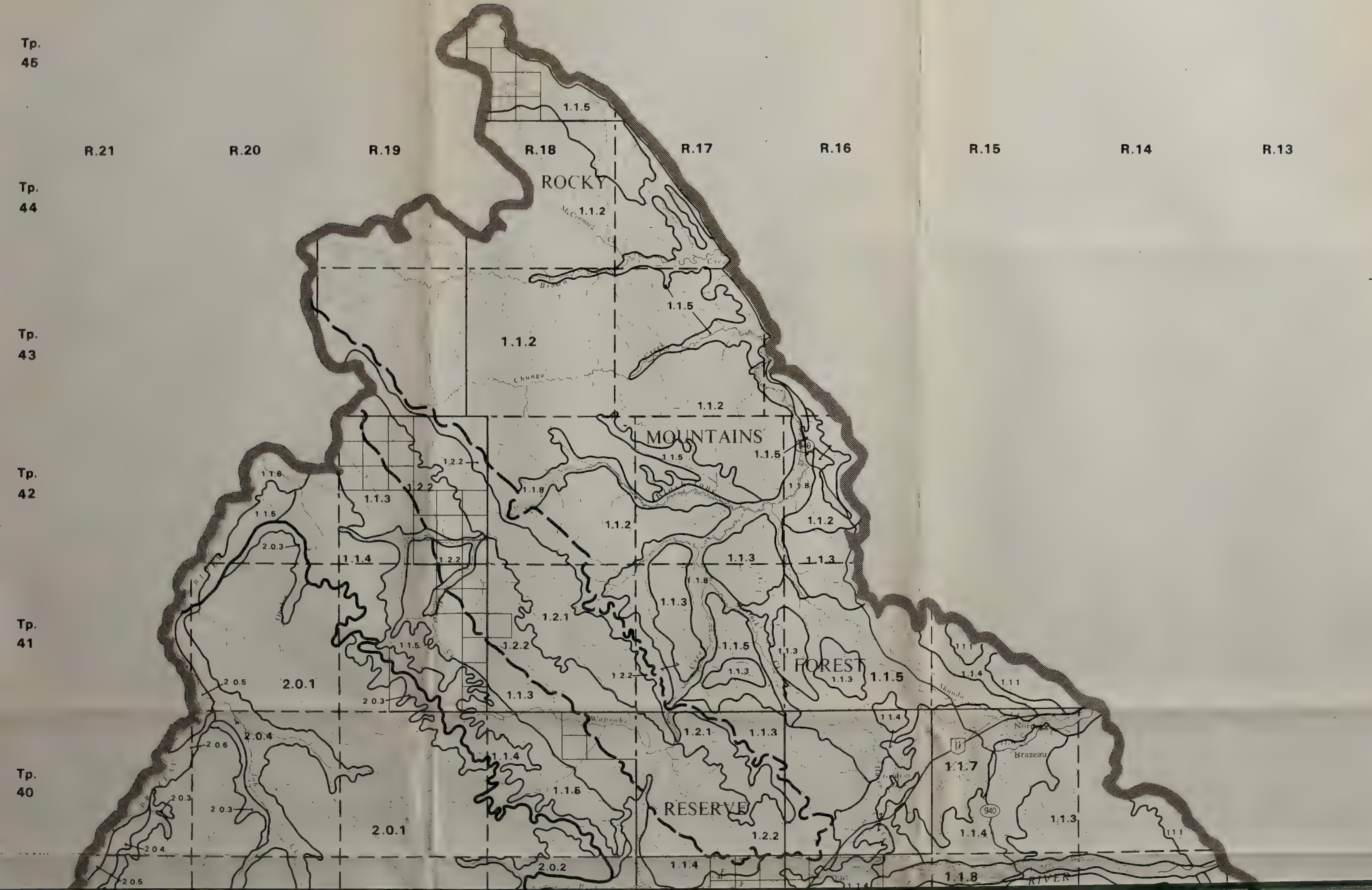

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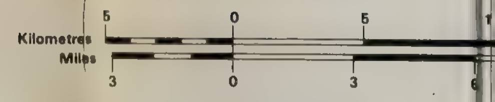


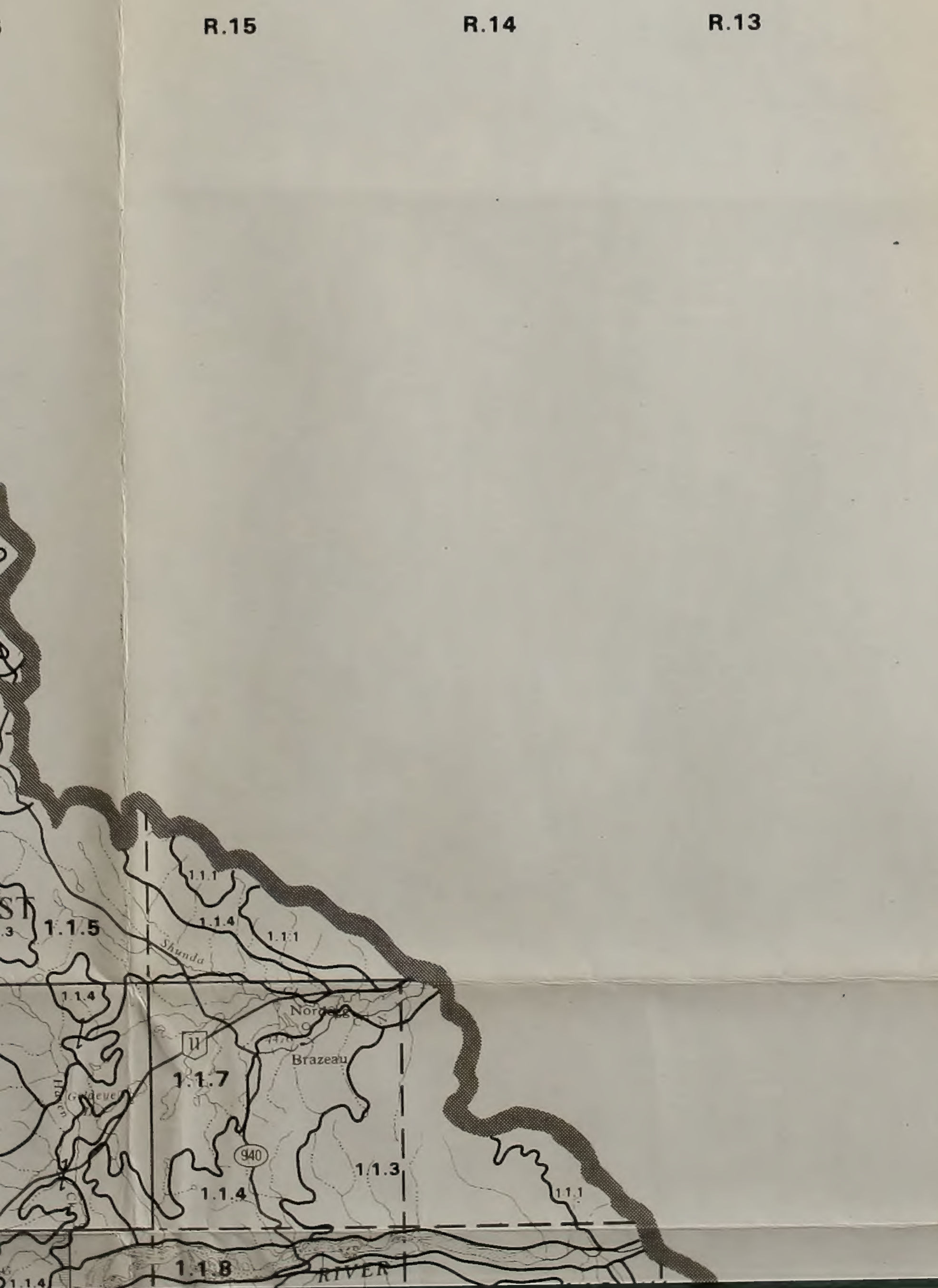
WEST OF THE

LEG

Geomorphic System	Parent Geologic Material	Surface Slo

1. ROCKY MOUNTAI

Steep, approximately parallel ridges with elevations
Upper and Lower Cretaceous, Jurassic and Triassic ro
are dominantly morainal and saprolite (residual mate
glaciofluvial, fluvial and organic materials are
Brunisols in combination with significant areas of
Regosolic soils.



GEOMORPHIC SYSTEMS
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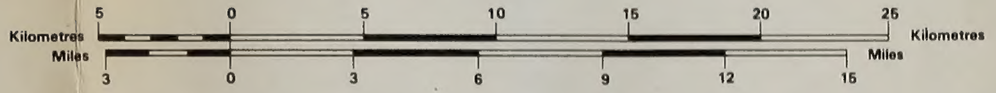


WEST OF THE FIFTH MERIDIAN

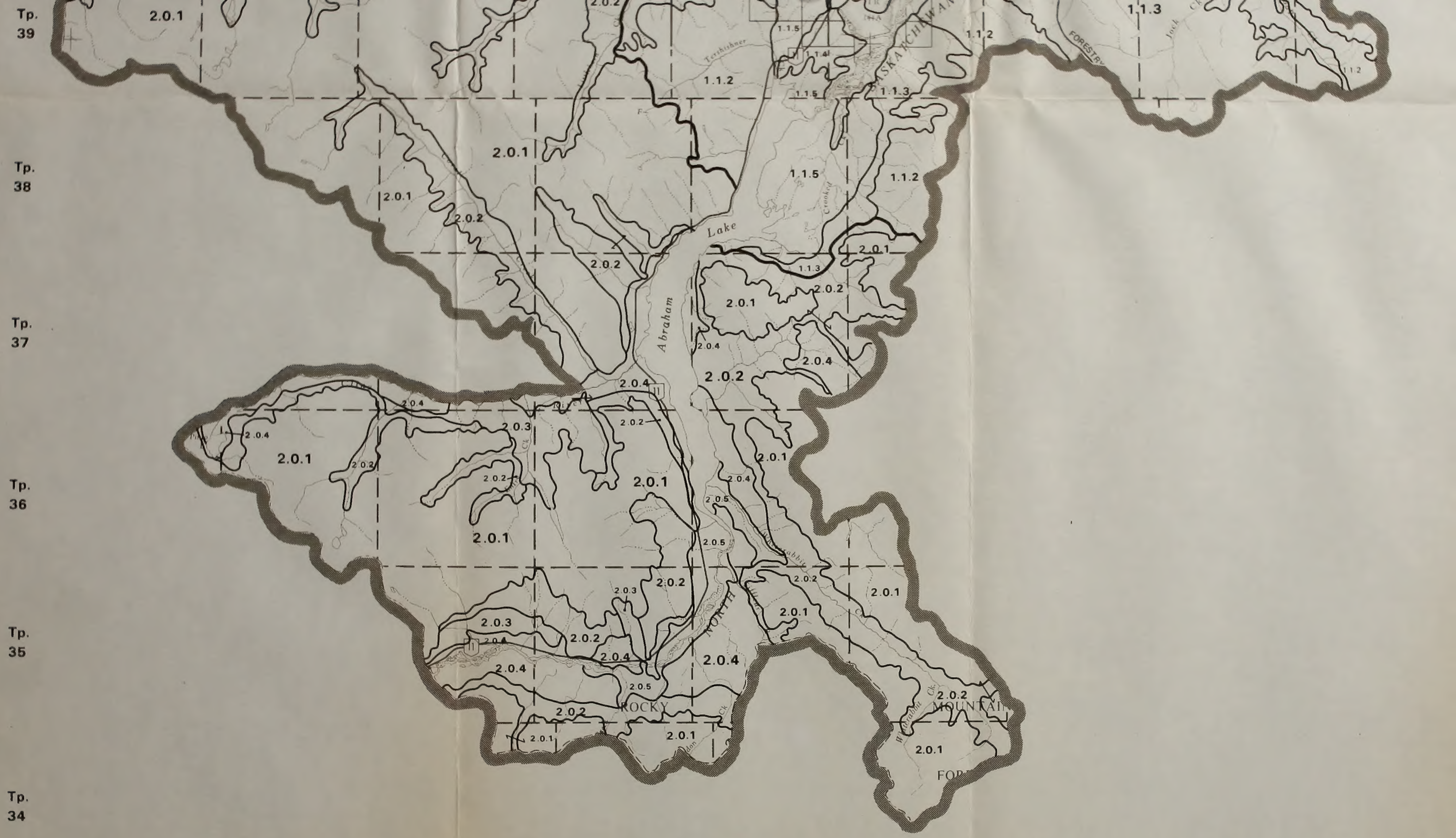
LEGEND

Geomorphic System	Parent Geologic Material	Surface Expression Slope	Soils

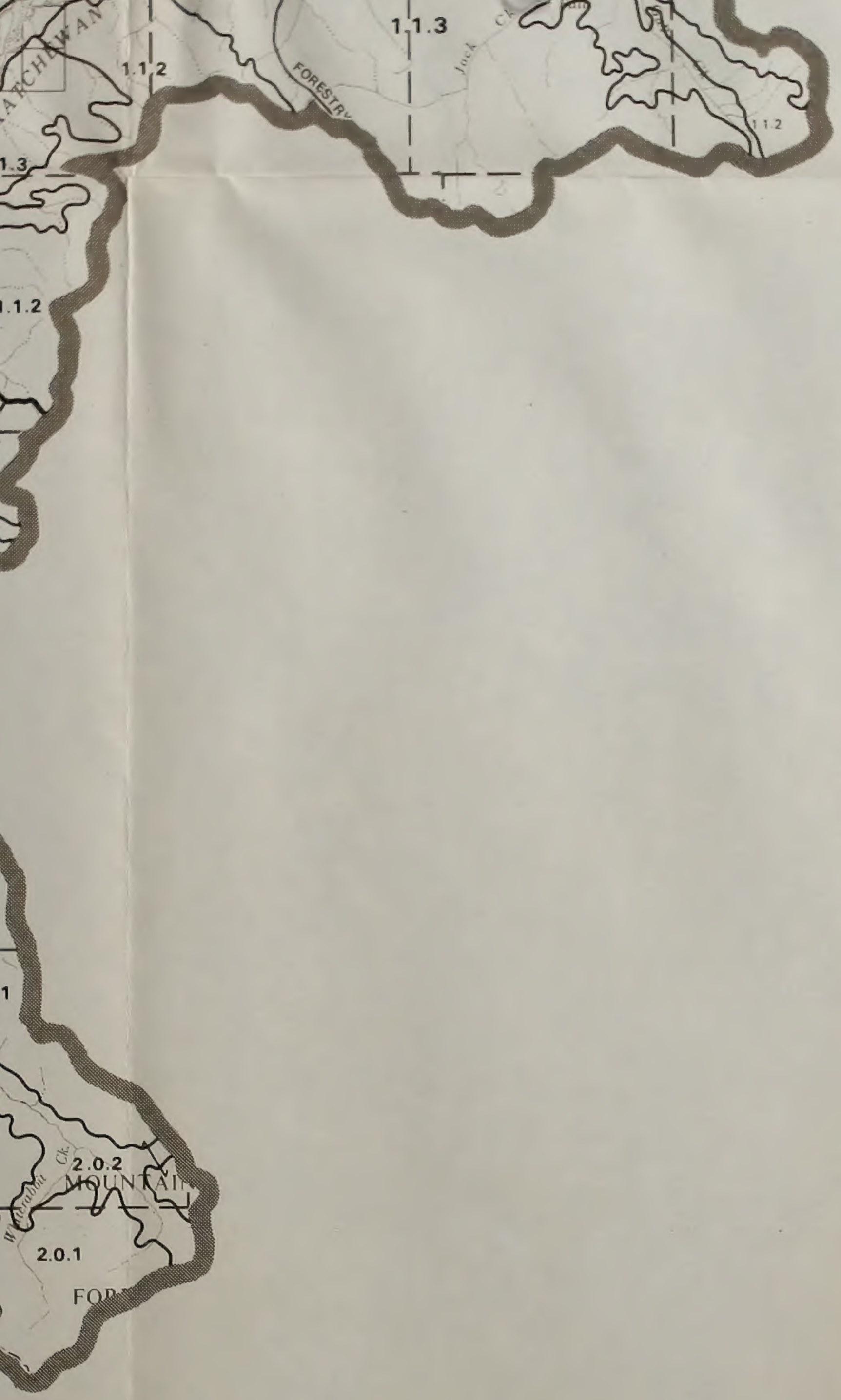
1. ROCKY MOUNTAIN FOOTHILLS REGION

Steep, approximately parallel ridges with elevations ranging from 1400 to 2000 masl. The bedrock consists of Upper and Lower Cretaceous, Jurassic and Triassic rocks, mainly sandstones and shales. The surficial materials are dominantly morainal and saprolite (residual material). Significant areas of colluvium, and small areas of glaciofluvial, fluvial and organic materials are also present. The soils are dominantly Eluviated Eutric Brunisols in combination with significant areas of Brunisolic Gray Luvisols, Eluviated Dystric Brunisols and Regosolic soils.

	over bedrock	Ridged, inclined, steep:	Eluviated Eutric Brunisols, some



Alberta
ENERGY AND
NATURAL RESOURCES



1.1.1	Saprolite veneer over bedrock	Ridged, inclined, steep; 45-100 percent	Eluviated Eutric Brunisols, some Eluviated Dystric Brunisols; frequent bedrock exposures
1.1.2	Morainal veneer and blanket over bedrock, significant areas of saprolite	Inclined, ridged, rolling; 15-70 percent	Eluviated Eutric Brunisols, significant areas of Eluviated Dystric Brunisol
1.1.3	Morainal veneer and blanket over bedrock, some colluvium	Inclined, ridged; 10-45 percent	Eluviated Eutric Brunisols; some Regosolic soils
1.1.4	Morainal veneer and blanket over bedrock, some fluvial	Inclined, undulating; 9-15 percent	Eluviated Eutric Brunisols, Brunisolic Gray Luvisols
1.1.5	Morainal blanket over bedrock, some organic	Undulating, inclined; 3-9 percent	Eluviated Eutric Brunisols, Brunisolic Gray Luvisols, some Organic soils
1.1.6	Morainal blanket over bedrock, some fluvial	Undulating, inclined, terraced; 3-9 percent	Eluviated Eutric Brunisols, Brunisolic Gray Luvisols, some Regosolic soils
1.1.7	Morainal blanket over bedrock, organic	Undulating, ridged; 3-9 percent	Eluviated Eutric Brunisols, Organic soils
1.1.8	Fluvial, some glaciofluvial, organic and morainal	Terraced, undulating, fan, level, inclined; 1-3 percent	Regosolic soils, some Eluviated Eutric Brunisols and Organic soils

1.2 Bighorn Range Subregion

Very strongly sloping to steep, northwest-southeast trending ridges with elevations ranging from 1600 to 2600 masl. The bedrock consists of Mesozoic and Paleozoic rocks, mainly limestone, dolomite, sandstone and shale. The surficial material is dominantly saprolite (residual material) and includes significant areas of till. The soils are mainly Eluviated Eutric Brunisols and Eluviated Dystric Brunisols with minor distribution of Regosolic soils.

1.2.1	Bedrock, fractured bedrock, some saprolite	Ridged, steep; 45-100 percent	Rock outcrops (barren land), some Regosolic soils
1.2.2	Saprolite, significant areas of morainal veneer over bedrock	Inclined, ridged; 30-70 percent	Eluviated Eutric Brunisols, Eluviated Dystric Brunisols

2. ROCKY MOUNTAINS REGION

Steep, sub-parallel, west dipping thrust blocks with elevations varying from 1300 to 3350 masl. The bedrock includes a variety of limestones, dolomite, sandstones and shales ranging in age from Pre-Cambrian to Jurassic. The surficial deposits are mainly fractured and partially weathered rocks, shallow residual and colluvial materials. Significant areas of till, glaciofluvial and fluvial deposits are found in major valleys. The soils are dominantly Eluviated Eutric Brunisols and Regosols.

2.0.1	Bedrock, fractured bedrock, some colluvium and saprolite	Ridged, steep; 45-100 percent	Rock outcrops (barren land), some Regosolic soils
2.0.2	Saprolite veneer over bedrock, colluvium, some morainal	Inclined, ridged; 30-70 percent	Eluviated Eutric Brunisols, Regosolic soils
2.0.3	Morainal veneer over bedrock, saprolite, some colluvium	Inclined; 15-45 percent	Eluviated Eutric Brunisols, some Regosolic soils
2.0.4	Morainal veneer and blanket over bedrock, significant areas of fluvial, some colluvium and saprolite	Inclined, undulating, fan, terraced, ridged; 3-15 percent	Eluviated Eutric Brunisols, Brunisolic Gray Luvisols, some Regosolic soils
2.0.5	Fluvial, some glaciofluvial	Fan, level, terraced; 1-9 percent	Regosolic soils, some Eluviated Eutric Brunisols and Brunisolic Gray Luvisols
2.0.6	Colluvium, fluvial, some morainal	Inclined, undulating, ridged; 3-9 percent	Regosolic soils, some Eluviated Eutric Brunisols

━━━	Physiographic Region
━ ━	Physiographic Subregion
───	Geomorphic System

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